Parsimonious Or Profligate: How Many and Which Discourse Structure Relations?

Eduard H. Hovy
USC/Information Sciences Institute
4676 Admiralty Way
Marina del Rey, CA 90292

Elisabeth Maier
Projekt KOMET, GMD-IPSI
Dolivostr, 15
D-6100 Darmstadt
Germany

1992
ISI/RR-93- 373

REPORT DOCUMENTATION PAGE

FORM APPROVED
OMB NO. 0704-0188

1. AGENCY USE ONLY (Leave blank)	2. REPORT DATE	3. REPORT TYPE AND DATES COVERED
	August 1992	Research Report

4. TITLE AND SUBTITLE
Parsimonious Or Profligate: How Many and Which Discourse Structure Relations?

5. FUNDING NUMBERS
FQ7619-89-03326-0001 and

6. AUTHOR(S)
Eduard Hovy

7. PERFORMING ORGANIZATION NAME(S) AND ADDRESS(ES)
USC INFORMATION SCIENCES INSTITUTE
4676 ADMIRALTY WAY
MARINA DEL REY, CA 90292-6695

8. PERFORMING ORGANIZATON REPORT NUMBER

9. SPONSORING/MONITORING AGENCY NAMES(S) AND ADDRESS(ES)
ROME Laboratories
Griffiths AFB
Rome, New York

10. SPONSORING/MONITORING AGENCY REPORT NUMBER
RR-373

11. SUPPLEMENTARY NOTES

12A. DISTRIBUTION/AVAILABILITY STATEMENT
UNCLASSIFIED/UNLIMITED

12B. DISTRIBUTION CODE

13. ABSTRACT *(Maximum 200 words)*

Over the past ten years, researchers studying the structure of discourse have consistently had to face questions such as the following: Given that discourses consist of segments, how do the segments relate? What intersegment relations are there? How many are needed? A fair amount of controversy exists, ranging from the parsimonious position (that two basic relations suffice) to the profligate position (that an open-ended set of semantic/rhetorical relations is required). This paper outlines the arguments and then summarizes a survey of the conclusions of approximately 30 researchers -- from linguists to computational linguists to philosophers to Artificial Intelligence workers. It fuses and taxonomizes the more than 400 relations they have proposed into a hierarchy of approximately 70 increasingly semantic relations, and argues that though the taxonomy is open-ended in one dimension, it is bounded in the other and therefore does not give rise to anarchy. Some evidence is provided for the organization of the taxonomy, as well as a full listing of the sources.

14. SUBJECT TERMS
discourse structure, rhetorical structure theory, computational linguistics, and discourse and text

15. NUMBER OF PAGES
33

16. PRICE CODE

17. SECURITY CLASSIFICTION OF REPORT	18. SECURITY CLASSIFICATION OF THIS PAGE	19. SECURITY CLASSIFICATION OF ABSTRACT	20. LIMITATION OF ABSTRACT
UNCLASSIFIED	UNCLASSIFIED	UNCLASSIFIED	UNLIMITED

GENERAL INSTRUCTIONS FOR COMPLETING SF 298

The Report Documentation Page (RDP) is used in announcing and cataloging reoprts. It is important that this information be consistent with the rest of the report, particularly the cover and title page. Instructions for filling in each block of the form follow. It is important to stay within the lines to meet optical scanning requirements.

Block 1. Agency Use Only (Leave blank).

Block 2. Report Date. Full publication date including day, month,a nd year, if available (e.g. 1 jan 88). Must cite at least the year.

Block 3. Type of Report and Dates Covered. State whether report is interim, final, etc. If applicable, enter inclusive report dates (e.g. 10 Jun 87 - 30 Jun 88).

Block 4. Title and Subtitle. A title is taken from the part of the report that provides the most meaningful and complete information. When a report is prepared in more than one volume, repeat the primary title, add volume number, and include subtitle for the specific volume. On classified documents enter the title classification in parentheses.

Block 5. Funding Numbers. To include contract and grant numbers; may include program element numbers(s), project number(s), task number(s), and work unit number(s). Use the following labels:

C - Contract	PR - Project
G - Grant	TA - Task
PE - Program Element	WU - Work Unit Accession No.

Block 6. Author(s). Name(s) of person(s) responsible for writing the report, performing the research, or credited with the content of the report. If editor or compiler, this should follow the name(s).

Block 7. Performing Organization Name(s) and Address(es). Self-explanatory.

Block 8. Performing Organization Report Number. Enter the unique alphanumeric report number(s) assigned by the organization performing the repor.

Block 9. Sponsoring/Monitoring Agency Names(s) and Address(es). Self-explanatory

Block 10. Sponsoring/Monitoring Agency Report Number, (If known)

Block 11. Supplementary Notes. Enter information not included elsewhere such as: Prepared in cooperation with...; Trans. of ...; To be published in... When a report is revised, include a statement whether the new report supersedes or supplements the older report.

Block 12a. Distribution/Availability Statement. Denotes public availability or limitations. Cite any availability to the public. Enter additional limitations or special markings in all capitals (e.g. NOFORN, REL, ITAR).

DOD	- See DoDD 5230.24, "Distribution Statements on Technical Documents."
DOE	- See authorities.
NASA	- See Handbook NHB 2200.2.
NTIS	- Leave blank.

Block 12b. Distribution Code.

DOD	- Leave blank.
DOE	- Enter DOE distribution categories from the Standard Distribution for Unclassified Scientific and Technical Reports.
NASA	- Leave blank.
NTIS	- Leave blank.

Block 13. Abstract. Include a brief (Maximum 200 words) factual summary of the most significant information contained in the report.

Block 14. Subject Terms. Keywords or phrases identifying major subjects in the report.

Block 15. Number of Pages. Enter the total number of pages.

Block 16. Price Code. Enter appropriate price code (NTIS only).

Blocks 17.-19. Security Classifications. Self-explanatory. Enter U.S. Security Classification in accordance with U.S. Security Regulations (i.e., UNCLASSIFIED). If form contins classified information, stamp classification on the top and bottom of the page.

Block 20. Limitation of Abstract. This block must be completed to assign a limitation to the abstract. Enter either UL (unlimited) or SAR (same as report). An entry in this block is necessary if the abstract is to be limited. If blank, the abstract is assumed to be unlimited.

PARSIMONIOUS OR PROFLIGATE: HOW MANY AND WHICH DISCOURSE STRUCTURE RELATIONS?

Eduard H. Hovy[1]

Information Sciences Institute
of the University of Southern California
4676 Admiralty Way
Marina del Rey, CA 90292-6695
U.S.A.

tel: +1-310-822-1511
fax: +1-310-823-6714
email: hovy@isi.edu

Elisabeth Maier

IRST
Loc. Panté di Povo
38050 Trento-Povo
Italy

tel: +39-461-81-0105
fax: +39-461-81-0851
email: maier@irst.it

Abstract

Over the past ten years, researchers studying the structure of discourse have consistently had to face questions such as the following: Given that discourses consist of segments, how do the segments relate? What intersegment relations are there? How many are needed? A fair amount of controversy exists, ranging from the parsimonious position (that two basic relations suffice) to the profligate position (that an open-ended set of semantic/rhetorical relations is required). This paper outlines the arguments and then summarizes a survey of the conclusions of approximately 30 researchers — from linguists to computational linguists to philosophers to Artificial Intelligence workers. It fuses and taxonomizes the more than 400 relations they have proposed into a hierarchy of approximately 70 increasingly semantic relations, and argues that though the taxonomy is open-ended in one dimension, it is bounded in the other and therefore does not give rise to anarchy. Some evidence is provided for the organization of the taxonomy, as well as a full listing of the sources.

[1]To appear in *Discourse Processes*, 1994.

The first author was supported by the Rome Air Development Center under RADC contract FQ7619-89-03326-0001.

1 Discourse Structure and Discourse Relations

One of the first observations one makes when analyzing discourse is that it exhibits internal structure. Whether the unit of analysis is morphophonemic, a clause, a sentence, a paragraph, or the whole discourse, units cluster together in specific ways to form larger units, so that most discourses, if they are coherent, consist of a relatively small number of top-level units.

Just as a sentence can be analyzed into syntactic, semantic, thematic, focus, and other structures, a discourse can be analyzed in many ways at once. To obtain some clarification of the numerous ways, one can arrange the structural units of description along various dimensions. One dimension compares the *unit size*, on a range from morphophonemic to full discourse length. Discourse structure has been extensively studied at most unit sizes or levels, from the intonational patternings of spoken discourse (prosodic differences at discourse segment endings are described by [Hirschberg & Litman 87, Pierrehumbert & Hirschberg 87]), through the subclausal (for example, shifts in tense and mode [Marslen-Wilson et al. 82] or pronominalizations respecting discourse segment boundaries [Björklund & Virtanen 89, Passoneau 91, Levy 84]), through clause-level clustering (often given by cue words and phrases such as "in order to" or "then" which guide the reader's understanding inferences by providing clues as to how the pieces of the discourse interrelate [Grimes 75, Mann & Thompson 88, Dahlgren 88]), all the way up to the overall structural skeleton of the discourse (macrostructures [Kintsch & Van Dijk 75], story grammars [Rumelhart 72], Generic Structure Potential [Hasan 78], or schemas [McKeown 85]).

Another dimension of organization compares the *function of the unit.* This dimension includes argument structure (the development and reasoning underlying the argument) [Toulmin 58, Birnbaum et al. 80, Sycara 87]; affective structure (also called plot units) [Lehnert 82]; genre-producing structure (the structural coarticulation of various presentation styles, as for example a recipe consists of a list followed by a set of imperatives) [Martin 92]; intentional structure (the goal/plan or task-related organization of the discourse) [Grosz & Sidner 86, Moore 89]; semantic structure (the expression of domain-specific and general world knowledge in generic structural patterns) [McKeown 85, Paris 87], and so on.

A discussion of this plethora of analysis levels and types, each with its own terms, rules, and idiosyncracies, requires several books. We wish to focus in this paper on a specific level of analysis — the clause level — because in the past seven or so years it has been the focus of considerable interest in the computational text planning and language generation community. Several theories of interclausal relations have been quite productive in suggesting new and powerful ways to plan coherent paragraphs of text automatically from information stored in computers in various non-linguistic ways. Although limited in this paper to the clause level, we believe the relations described here pertain as well to both the subclause and the macrostructure levels; this will in many cases be obvious to the reader. We also believe that the kinds of relations described

provide a basis for many, if not all, the functions of discourse units, whether the analysis focus on argument structure, intentional structure, affective structure, etc.

In this paper we make the following simplifying assumptions. A discourse (a spoken or written text) is a structured collection of clauses. The clauses are grouped into segments on intentional, semantic, and other grounds; the nesting of segments form to larger segments provides the discourse structure. A discourse can be represented as a tree structure, in which each node of the tree governs the segment (subtree) beneath it. At the top level, the discourse is governed by a single root node if it is coherent; at the leaves, the basic segments are single grammatical clauses. In every coherent discourse, juxtaposed segments are related depending on the underlying interrelationships and dependencies among their contents.

Though many of these assumptions do not do justice to the complexity of real discourse — in particular, considerable evidence exists that discourse is not representable simply as a tree structure [Trabasso et al. 85, Graesser & Clark 85] — we consider them useful insofar as they enable computational experiments to be performed with text planners and generators. Such experiments, which include interactive data base question answering systems [Arens et al. 88], explainable expert systems [Moore & Swartout 90], and tutoring systems [Moore 89], can then be compared to human-human interactions and judged on the grounds of discoursal and functional adequacy, and shortcomings due to the simplifications can be identified, studied, and corrected.

1.1 The Problem: The Number of Relations

The study of discourse structure is severely hampered by the well-known difficulty of reliably identifying the discourse segments (but see [Passoneau & Litman 93] for some recent promising work). Any clues to segmentation, such as the cue words that indicate segment interrelations, are helpful. Since, as has been argued fairly generally, discourses are coherent by virtue of the rhetorical or semantic relationships that hold between segments [Aristotle, Grimes 75, Hobbs 79, Mann & Thompson 88], one can instead try to identify the set of interclausal relations people use, and from them try to infer something about discourse structure.

These relations, which govern the juxtaposition of clauses and clause clusters whatever the genre of the discourse and whatever task or function it fulfills, form natural building blocks of discourse structure. As such, in one way or another, the relations play a role in all the major computationally and logically oriented approaches toward the study of discourse. But even in the simplified view of discourse used in computational approaches, the nature and number of intersegment discourse relations is a serious problem, one that has become more relevant in recent years, as computational work on discourse has been attempted. This paper proposes a resolution of the problem, which can be stated in terms of two possible positions.

On the one hand, approaching the problem of discourse structure from several intellectual subfields, various researchers have produced lists of intersegment relations — from philosophers (e.g., [Toulmin 58]) to linguists (e.g., [Quirk & Greenbaum 73, Halliday 85]) to computational linguists (e.g., [Hobbs 79, Mann & Thompson 88, Knott & Dale 93]) to psycholinguists (e.g., [Sanders et al. 92, Redeker 91]) to logicians (e.g., [Asher 93]) to Artificial Intelligence researchers (e.g., [Schank & Abelson 77, Dahlgren 88]). Typically, their lists contain between five and thirty relations, though the more detailed the work, the more relations tend to be identified. In this paper, we call the position of these researchers, namely that (at least) tens of interclausal relations are required to describe the structure of English discourse, the *Profligate Position.*

On the other hand, some researchers, notably [Grosz & Sidner 86], prefer not to identify a specific set of such relations. They argue that trying to identify the "correct" set is a doomed enterprise, because there *is* no closed set; the closer you examine intersegment relationships, the more variability you encounter, until you find yourself on the slippery slope toward the full complexity of semantics proper. Thus though they do not disagree with the idea of relationships between adjacent text segments provide meaning and enforce coherence, they object to the notion that some small set of relations can describe English discourse adequately. As a counterproposal, Grosz and Sidner avoid the semantic effects on the structure of discourse by defining two basic structural relations, DOMINANCE and SATISFACTION-PRECEDENCE, which carry intentional (that is, goal-oriented, plan-based) but no semantic import. They use these relations in their theory of the structure of discourse, according to which some pieces of the text are either subordinate to or on the same "level" as other pieces with respect to the interlocutors' intentions. We call this position, namely that two intersegment relations suffice to represent discourse structure, the *Parsimonious Position.*

Comparing the two positions, the following questions arise:

- Is there a set of relations that people use?
- If so, which relations, and how many, are there?
- How are they defined? How are they best represented?
- How can they be used in computational text planners?
- How can one manage the problem of increasing semantic complexity?

1.2 Comparing the Alternatives

Depending on the depth of analysis required, the Parsimonious approach may be satisfactory. Certainly one can produce a discourse structure using only the two parsimonious relations. For discourse processing, however, the two relations are not sufficient. For example, when generating the following two clauses

"Joe's car is much admired because it is a red sports car."

the author needs to know which semantic interrelationship to express: should the linking word be "because", "when", "unless", or none at all? It is the semantic relation of causality that provides the appropriate linking word and much of the structural/realizational information (had the interclausal relationship been temporal coincidence, the cue word would have been "when"; had it been elaboration, the second clause would have been subordinated to the first in a relative clause "Joe's car, which is...", and so on). As practical experience with text generation systems has repeatedly shown [McKeown 85, Hovy 88, Moore & Swartout 90, Paris 90, Rankin 89, Cawsey 90, Maybury 90, Dobeš & Novak 92], the two parsimonious relations alone do not provide enough information to allow the generation of appropriate cue words/phrases, syntactic forms, pronouns, etc.

Similarly, text analysis systems cannot provide adequate interpretations on parsimoniously structural considerations alone. In the following:

"Joe bought the sports car. He came into his inheritance."
"Joe came into his inheritance. He bought the sports car."

the reader knows in both sentences that the time of inheritance precedes the time of buying, regardless of clause order, because of causal knowledge and an assumption that the discourse is coherent. An account of this discourse that ignores the causal relationship simply doesn't provide very much useful information and certainly doesn't ensure successful communication.

Based on the text planning argument outlined above, we believe that one cannot provide a sufficient account of discourse structure without using semantic/rhetorical relations. In addition, [Moore & Pollack 93] argue convincingly that for an adequate description of discourse at the clause level, one needs to represent the author's intentions in relating the clauses as well as the semantic relationships between them. Apparently we are forced into the profligate position. But how many relations are there? What are they? Which of the many collections of relations is correct?

The solution we propose is to use just as many relations as are required for the task or type of analysis being done. When the analysis requires merely partitioning a discourse into segments, as used in [Grosz & Sidner 86] and [Polanyi 88], the two parsimonious relations may well suffice. Here an analogy to syntactic classes may be instructive. It is possible to represent the syntactic structure of any sentence by using only the two relations Immediate Dominance and Linear Precedence, as done in the GPSG work on the ID/LP format for grammars [Gazdar et al. 85, Shieber 84]: these relations suffice to construct a tree. On the other hand, it is also possible to represent the syntactic structure of any sentence using a much richer set of terms, in the limit as rich as the actual verb itself to govern the predicate. Such an approach is in fact advocated by

[Gross 84, Mel'čuk & Žholkovsky 70], who show that almost every verb is a class by itself, since almost every verb has in some aspect or other a unique predicate structure. Under their account, an adequate syntactic representation of any sentence requires not merely general terms such as VERB or TRANSITIVE-VERB but instead the actual verb name itself.

On the one hand, then, the parsimonious position: just two relations, and very little information about the classes involved. On the other hand, the profligate position: numerous relations, and much information about the classes involved. While the parsimonious syntax trees are easy to construct, they are not very informative; and while the profligate tree are very informative, they are difficult to construct. In practise, as with most things in life, most syntacticians compromise. They employ for syntactic descriptions a set of terms such as VERB, NOUN, ADJECTIVE, etc., that is neither as large as Gross or Mel'čuk and Žholkovsky would prefer, nor as small as used in the ID/LP format; simultaneously the terms are not as informative as those Gross or Mel'čuk and Žholkovsy provide nor as stark as those in ID/LP. Where necessary for the task at hand, people use more (or less) detailed terms, suffering the consequences of not being able to define them precisely (or losing information, respectively).

The analogy to the question of discourse structure relations is direct. While the two parsimonious relations provide as much information as one needs to build a tree, they do not convey the kind of information that a typical text generator requires, for example, to include appropriate structural cue words and phrases to guide the reader's inferences. On the other hand, as Grosz and Sidner say, if one attempts to describe the true semantic interrelationships among the various segments of the discourse, one is drawn into the quagmire of full semantic complexity, and as they show, such detail is not always pertinent in discussions of discourse structure.

We propose for general use a compromise solution of approximately 70 discourse structure relations, applicable at the clause level and higher. In the rest of the paper we provide these 70 relations, organized into a hierarchy of increasing specificity, and describe their sources and our taxonomization procedure. We believe that these relations play an important role in English discourse structure, and we have organized them to allow straightforward extension in a constrained way when more detail is required.

2 Collecting and Organizing Discourse Structure Relations

In a study spanning the past three years, the authors have collected intersegment clause-level discourse relations that are expressive enough to satisfy the requirements of text planning systems. In 1989, the first author collected and taxonomized over 350 such relations from approximately 30 researchers in various fields [Hovy 90b], including philosophy, linguistics, computational linguistics, psycholinguistics, and Artificial Intelligence. The collection work involved comparing names

and definitions (described in Section 2.1) and then taxonomizing relations in a single hierarchy (described in Section 2.3). Subsequently, the authors found over 50 additional relations in other sources and produced an improved taxonomization, consisting of about 70 relations, first reported in [Maier & Hovy 92]. This taxonomy is still being extended; see [Hovy et al. 92]; in particular, we are currently collecting attempts to provide precise, formal definitions of these relations, notably from [Sanders et al. 92, Martin 92, Hobbs 90, Lascarides & Asher 91, Asher 93].

In this paper, rather than attempt to define each relation (an exercise requiring too much space), we refer the reader to the various sources, particularly to [Mann & Thompson 88, Hobbs 79, Sanders et al. 92, Ivir et al. 80, Martin 92]. In order to facilitate further research, particularly comparisons of the relations and definitions we encountered, the relations, sources, and a cross-index for each relation appear in the Appendix.

2.1 Merging Relations from Different Sources

Deciding whether or not to merge two similar-looking relations from different sources is a task bedeviled by two factors: differences in nomenclature and the frequent lack of any explicit definition at all[2]. The central problem lies in comparing definitions and/or examples. Since space limitations preclude a full description of all our decisions, we illustrate our treatment and own definitions of two example relations, ELABORATION and CONCESSION.

2.1.1 The Relation ELABORATION

We compare several definitions and examples of relations which were labeled ELABORATION by the sources and check them for identity of meaning.

Hobbs 90:

> **Definition:** *Infer the same proposition P from the assertions of S0 and S1 (where S0 and S1 stand for the two text segments linked by the relation).*
>
> **Example:**
>
> 1. Go down First Street.
> 2. Just follow First Street down three blocks to A Street.

From the first sentence the reader can infer that he/she has to go down First Street to an unspecified goal. The second sentence allows the same inferences except that the goal ("A Street") and

[2]We do not wish to cast aspersions on any source; defining semantic relations is a very difficult problem. For example, nobody has a general definition of CAUSE, though causality has been the topic of centuries of debate! Even limited definitions, as required for the purposes of Artificial Intelligence or Computational Linguistics computer programs in a particular application domain with a given ontology of terms, are difficult enough.

the distance ("three blocks") are specified. There is a certain set of inferences which coincide for both sentences. In this example the second sentence gives additional detail to the first (although for Hobbs this does not necessarily have to be the case; his definition includes exact reformulations of the first clause by the second).

Halliday 85:

> **Definition:** *One clause expands another by elaborating on it (or some portion of it), restating it in other words, specifying in it greater detail, commenting or exemplifying.*
>
> **Example:**
>
> 1. John didn't wait.
> 2. He ran away.

Halliday's definition, which is restricted to linking simple clauses, explicitly allows both for relations that simply restate and for relations that provide more detail. This way, Halliday hints that the ELABORATION relation can be subclassified into various subcategories.

Rhetorical Structure Theory — Mann and Thompson 87:

> **Definition:** *The Satellite [the clause of less importance] presents additional detail about the situation or some element of the subject matter which is presented in the Nucleus, or is inferentially accessible from the Nucleus, in one or more of the ways listed below:*
>
> - *abstract - instance*
> - *set - member*
> - *whole - part*
> - *object - attribute*
> - *generalization - specific*

Besides the fact that this relation is the most detailed we have encountered — it specializes into five subclasses — it does not, like the definitions of Hobbs and Halliday, explicitly include restatements; for this function Mann and Thompson define a separate relation RESTATEMENT.

Dahlgren 88:

> **Definition:** *One clause gives details about or describes a part of a larger event reported in the other clause.*

Being limited to events, Dahlgren's definition is narrower, specifying under ELABORATION a subset of the phenomena included by Mann and Thompson.

The definitions reproduced here are representative of those for elaborations (and somewhat more explicit than most sources' descriptions). As is clear, the sources have a common understanding of the semantics of this relation. For ELABORATION, we base our definition on the above ones to get:

Definition: *One text segment expands on the other by specifying it in greater detail or specifying it in other words, according to one of the following ways:*

- *set-member*
- *process-step*
- *part-whole*
- *object-attribute*
- *abstract-instance*
- *general-specific*
- *restatement*

2.1.2 The Relation CONCESSION

In this subsection we merge several sources' relations, all with different labels, into into one relation.

Hobbs 90:

Name: VIOLATED EXPECTATION

Definition: *Infer P from the assertion S0 and not-P from the assertion S1.*

Example:

- The paper is weak,
- but it is interesting.

From Hobbs's explanation, it becomes clear that the concessive meaning of the relation is meant: the reader makes assumptions about one of the propositions or text segments which are violated by what is said in the other segment.

Ivir et al. 80:

Name: CONTRADICTION

Definition: *The Relator [the discourse structure relation] implies that S2 is not [an] expected consequence of S1.*

Example:

1. He is not polite,
2. but I like him.

Again, both the definition and the example imply a concessive meaning. The same is the case in the definition Dahlgren gives for her QUALIFICATION relation:

Dahlgren 88:

> **Name:** QUALIFICATION
>
> **Definition:** *A qualification denies one of the implications of the event or state expressed by the other clause. The main clause in the relation qualifies the "though" clause.*
>
> **Example:**
>
> 1. Though Levine pleaded for sympathy,
> 2. the judge was unmoved.

Sanders et al. 92: Sanders et al. develop four basic parameters and define all their relations in terms of the parameter values. The parameters are:

- relation type: either additive or causal;
- pragmatic: specifying whether the relation conveys some illocutionary meaning;
- basic order: indicating a preferred sequence for the text segments;
- polarity: indicating whether one of the segments is negative or not.

Their relation NEGATIVE ARGUMENT – CLAIM is defined as follows:

> **Name:** NEGATIVE ARGUMENT – CLAIM
>
> **Definition:** *causal, +basic-order, +pragmatic, -polarity*
>
> **Example:**
>
> 1. Although it is not exactly shouted from the rooftops,
> 2. you will have to take into account that sharks may occur along the Yugoslavian coast.

From these and similar definitions, we create the CONCESSION relation, defined as:

> **Definition:** *One of the text segments raises expectations which are contradicted / violated by the other.*

2.2 Correctness of the Relations

One question always asked about efforts of this type: What guarantee exists that the relations collected and merged here are indeed the "right" ones? Or the only ones? It is not difficult to come up with relations that differ in some way from those in the Appendix and that do not neatly fall under a single item in the taxonomy shown in the next section.

This is a standard objection to *any* set of terms proposed to fulfill some function. The standard response holds here too: there is no guarantee that these are the "right" relations, whatever "right" may mean[3]. The particular relations proposed here are certainly open to question, but their strongest support is that they are a synthesis of the terms proposed in over 30 different investigations from different fields. The possibility always exists that new interclausal relations will be needed that cannot be subsumed under existing nodes in the taxonomy, though we believe this to be unlikely, based on our experience in compiling the hierarchy: halfway through this study, the topmost tiers had essentially been established, and almost all new relations found were simply specializations of existing ones. We expect that when new domains are investigated, the hierarchy will grow primarily at the bottom, and that the ratio of the number of relations added at one level to the number of relations added at the next lower level will be low, for all levels. In addition, as has been mentioned before, there is mounting evidence from actual attempts at constructing working systems (text planners and discourse analyzers) that intersegment relations of this type are required to guide inference and planning processes.

The collected relations are listed in the Appendix. We next turn to the question of taxonomizing them.

2.3 Organizing the Relations

Given the semantic overlaps of many of the relations, it was soon clear that they could be taxonomized somehow. The most informative taxonomization was a traditional two-dimensional hierarchic organization of increasing semantic specificity, with one dimension constrained in the number of relations and the other unconstrained (thus the more general a relation is, the higher it is in the hierarchy, while the more a relation is specified to distinguish it from others, the more its semantics are enhanced, and the lower it appears in the hierarchy).

Here an objection raised by the Parsimonious Position applies: The taxonomy, being unbounded toward the bottom, places one on the slippery slope toward having to deal with the full

[3]Similarly, there is no guarantee that the terms VERB, NOUN, ADJECTIVE, ADVERB, etc. are the "right" and "only" labels for types of words; they have simply been canonized by long use and much experience. Other terms may appear more natural in other languages, such as in languages that make no syntactic or morphological distinction between nouns and adjectives.

complexity of semantics. Simply working on the structure of discourse is difficult enough without bringing in the complexity of semantic knowledge. The response: There is no reason to fear the complexity of an unbounded set of terms, whether semantic or not, as long as the terms are well-behaved and subject to a pattern of organization which makes them manageable. A taxonomization of the terms in which all the pertinent information about discoursal behavior is captured near the top (which is maximally general, bounded, and well-understood) and not at the bottom (which permits unboundedness and redundancy) presents no threat to computational processing. Each discourse relation simply inherits from its ancestors all necessary processing information, such as cue words and realization constraints, and adds its unique peculiarities, to be used for inference (in parsing) or for planning out a discourse (in generation). Increasing differentiation of relations, continued until the very finest nuances of meaning are separately represented, need be pursued only to the extent required for any given application. Thus "unbounded" growth of semantic relations is not a problem, as long as they can be subsumed under existing nodes in the taxonomy.

The top tier of the hierarchy presented the most serious problems. A top-level organization ideally should satisfactorily reconcile the Parsimonious and Profligate positions and make possible the most constrained and yet predictive theory of discourse structure relations, thereby enabling the clearest generalizations. However, attempts to taxonomize all the relations under DOMINATES and SATISFACTIONPRECEDES or under Halliday's three top-level relations ELABORATION, ENHANCEMENT, and EXTENSION both failed, proving either unworkable or not informative enough (see [Hovy 90b]).

Recent work in computational discourse analysis and generation increasingly suggests that several parallel and non-isomorphic structural analyses should be given for a discourse at the clause level and upward: [Moore & Pollack 93] argue for the differentiation of semantic and intentional information into two distinct discourse structures, [Redeker 93] and [Lambert & Carberry 91] each propose different triple parallel analyses of discourse structure, and [Hovy 93] names four different perspectives at the clause level and above that require a distinct structure.

In line with such arguments, and following our text planning experience with relations from Rhetorical Structure Theory [Mann & Thompson 88, Mann & Thompson 86], as reported among others in [Hovy 88, Hovy 90a, Maier & Brown 90, Hovy et al. 92], we decided that a functional perspective is the most illuminating to take. We therefore partitioned the relations into three broad groups according to which primary function they perform in text. (A similar subcategorization strategy was discussed in [Mann & Thompson 88]). The three functions themselves are motivated by Halliday's subcategorization of linguistic phenomena into three so-called metafunctions *ideational* (i.e., semantic), *interpersonal* (i.e., author- and/or addressee-related), and *textual* (i.e., presentational) [Halliday 85]. As described below, semantic information such as causality, generalization, class membership, temporal sequentiality, etc., is expressed by ideational relations;

interpersonal relations express the author's communicative goals such as to describe, motivate, explain, etc.; and textual relations are used to form the discourse into a coherent whole, determining pronouns and other anaphora usage or linearizing sequences of topics.

The taxonomy under this three-way subcategorization is given in Figure 1. The number associated with each relation indicates the number of different researchers who have listed the relation and may be interpreted as a vote of confidence in it.

In this section we motivate the top-level classification into three parts by appealing to factors central to text planning: the types of information required to define and use the relations and the resulting types of illocutionary and perlocutionary effects that the relations have in the discourse.

2.3.1 Ideational Relations

We define ideational (i.e., semantic) relations between adjacent segments of material as those relations that express some experience of the world about us and within our imagination. This knowledge is of course shared by but not limited to the discourse interlocutors.

We have classified the ideational relations, such as ELABORATION and its various subtypes, SEQUENCE, CIRCUMSTANCE, CONTRAST, etc. (see Figure 1), together, since they are all defined with respect to their semantic properties. For example:

"Ben poured coffee into the cup. When next he looked, he saw that it had been drunk."

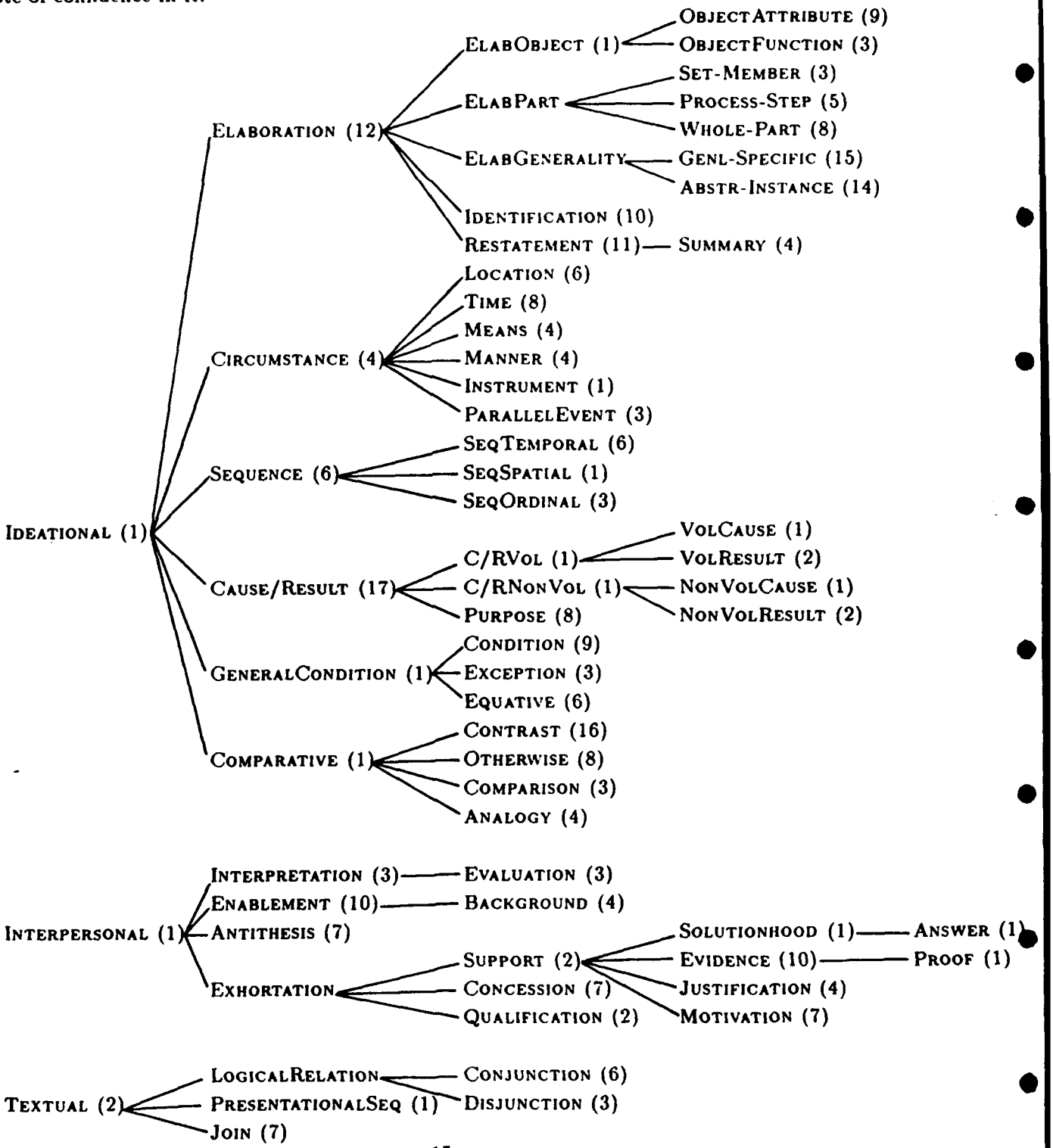
The sequential relationship between the two clauses is cued by the word "when" and by the referential identification of "Ben" with "he" and "coffee" with "it". The temporal (semantic) sequentiality of the second clause after the first is given by the fact that Ben's discovery could only occur *after* he poured the coffee into the cup. The interclausal relation SEQUENCE must be specified in terms of the underlying temporal relationship between the events mentioned in the two clauses — a semantic fact about the world.

Given their semantic nature, the use of ideational relations can be determined by means of operations on a knowledge base in a computer. In many instances, relations can be mapped onto knowledge base constructs; for example, the GENERAL-SPECIFIC subtype of ELABORATION can be mapped onto IS-A or CONCEPT-INSTANCE links in conventional knowledge representation formalisms. No explicit reference to a user model or any other external source of knowledge is generally required.

2.3.2 Interpersonal Relations

We define interpersonal relations as holding between adjacent segments of textual material by which the author attempts to affect the addressee's beliefs, attitudes, desires, etc., by means

Figure 1: A taxonomy of discourse segment relations. The number associated with each relation indicates the number of different researchers who listed the relation and may be interpreted as a vote of confidence in it.



of language. The perlocutionary effects achieved by these relations are convincing, enabling, motivating, giving evidence, interpreting and evaluating.

We found that relations such as MOTIVATION, JUSTIFICATION, ANTITHESIS, all necessarily involve in their definitions the addressee's knowledge, beliefs, or attitudes toward the propositional content of the text. For example,

> *"The new Tech Report abstracts are now in the journal area of the library near the abridged dictionary. Please sign your name by any that you would be interested in seeing."* (from [Mann & Thompson 88])

The enabling relation that holds between the two sentences concerns the addressee's knowledge and desire to express his or her interests in certain Tech Reports. It is not possible to define the interclausal relationship used without reference to the addressee. This essential aspect of interpersonal relations is reflected in the Mann and Thompson's definitions (*ibid.*) of, say,

- EVIDENCE:
  The reader's comprehending the satellite increases his belief of the nucleus.
- MOTIVATION:
  Comprehending the satellite increases the reader's desire to perform the action presented in the nucleus.

Other interpersonal relations, such as INTERPRETATION and EVALUATION, must be defined in terms of the goals and intentions of the author.

Since the use of interpersonal relations is predicated mainly on the interests, beliefs, and attitudes of the addressee and/or author, relations of this type are usually defined in a computer system with respect to a user model.

2.3.3 Textual Relations

We define textual (i.e., presentational) relations as holding between adjacent segments of text that are not meant to be directly related ideationally or interpersonally, but whose relationship exists solely due to the juxtaposition imposed by the nature of the presentation medium.

Typically, the "linear" nature of language enforces the use of relations for presentational purposes; examples are CONJUNCTION and PRESENTATIONALSEQ. For example, the latter is used as follows:

> *"There are a number of criteria for distinguishing Ranges from Goals:* **First**, *the Range cannot be probed by* do to *or* do with, *whereas the Goal can.* **Second**, *since nothing is being 'done to' it, a Range element never can have a resultative Attribute*

added within the clause, as a Goal can... **Next**, *the Range cannot be a personal pronoun, and it cannot normally be modified by a possessive.* **Finally**, *a range element (other than one with an 'empty' verb like* have *or* do*) can often be realized as a prepositional phrase and under certain conditions it has to be....*
(from [Martin 92], with text formatting removed. The semantics of text formatting instructions and their relationship to intersegment relations is discussed in [Hovy & Arens 90].)

The text makes no claim about the semantic orderedness of the sentences enumerated; these clauses could have appeared in any order.

Most collections of intersegment discourse relations indiscriminately intermix explicitly presentational relations with ideational and interpersonal ones. This, we believe, is due to the fact that *all* intersegment relations play some presentational role in text, which causes a certain amount of confusion. However, for most relations the presentational function is not primary, and when one is aware of this distinction, the problem is greatly reduced. One major remaining source of difficulty is the SEQUENCE family, since in English the same cue words and other textual markers are used to signal presentational sequence as semantic sequence. We solve the problem by creating the purely textual relation PRESENTATIONALSEQ.

A further reason for distinguishing the three classes is their difference in illocutionary force. All the ideational relations are expressed by the single illocutionary act DESCRIBE, while the interpersonal relations are expressed by various perlocutionary acts, including CONVINCE, MOTIVATE, and JUSTIFY. The consequences of this difference on the design of text planning systems are outlined in [Maier & Hovy 92].

2.4 Suggestive Evidence for the Structure of Lower Levels of the Taxonomy

Some nonconclusive evidence supports our organization of the lower portions of the hierarchy, though further study must be done to examine all the relations. This evidence is based on a sensitivity to generalization evinced by many cue words and phrases and syntactic realizations. For example, the cue word "then" is associated with SEQUENCE, and can be used appropriately to indicate its subordinates SEQTEMPORAL and SEQSPATIAL, as in:

SEQTEMPORAL: *"First you play the long note,* **then** *the short ones"*
SEQSPATIAL: *"On the wall I have a red picture,* **then** *a blue one"*

In contrast, the cue words for the two subrelations are specific and cannot be interchanged without introducing the associated connotation:

SEQTEMPORAL: *"***After** *the long note you play the short ones"*
SEQSPATIAL: *"***Beside** *the red picture is the blue one"*

Thus the relation associated with "then" subsumes the relations associated with "after" and "beside", mirroring the structure of the taxonomy. Similar observations hold for a number of the relations, including SOLUTIONHOOD and RESTATEMENT.

Preliminary investigation indicates possible additional evidence in the syntactic realization of some relations: When a relation typically gives rise to a dependent clause, then its subrelations tend to do so as well. This surmise requires study by linguists and is given here as a suggestion. (As is illustrated by the work of [Martin 92], syntactic commonalities between relations typically occur toward the fringes of our taxonomization rather than toward the top.)

3 Conclusion

A rather gratifying result of the synthesis presented here is that a relatively small number of core relations, organized into three principal types, suffice to cover essentially all types of clause-level intersegment relations proposed by the sources. This suggests that other relations not yet in the hierarchy are likely to be subtypes of relations already in it, preserving the boundedness of the number of relation types.

While we do not claim that discourse structure relations of the type presented in this paper suffice to capture all aspects of discourse structure, we believe that the relations are a necessary part of any structural description of coherent discourse. The author's intentions, decomposed into the purpose of each discourse segment and related using interpersonal relations, co-direct the formation of the discourse together with the semantic material and their ideational relations. The surface form of the discourse is captured in a presentationally oriented discourse structure in which textual relations figure. Any account of discourse structure that ignores these types of intersegment relations is incomplete in an important way.

While some evidence is provided for the structure of the hierarchy, we make no claim that this taxonomy is complete or correct in all details. It is certainly open to elaboration, enhancement, and extension! Our hope is that it will serve the community by providing a common starting point and straw man for future work on discourse structure.

4 Acknowledgments

Thanks to John Bateman, Marcus Brown, Robin Cohen, Robert Dale, Christian Matthiessen, Kathleen McCoy, Kathleen McKeown, Johanna Moore, Mick O'Donnell, Cécile Paris, Gisela Redeker, Ted Sanders, Wilbert Spooren, to several anonymous reviewers, and to everyone who

sent us their relations. We are still collecting relations and continuing to update the taxonomy... a task like this is never completed.

5 Appendix

The discourse structure relations taxonomized in Figure 1 was drawn from the following sources (the researchers, identified by initials, are listed after the table. In the parenthesized comments, *A* stands for author and *R* for reader):

Ideational	MH
Elaboration	MT, JH, JG, MP, GH, BF, KD, DSN, QG, MH, IMM, LA
Elab-Object	IMM
Object-Attribute	MT, HI, HL, KM, LP, JG, MP, MM, MH
Object-Function	HL, KM, MP
ElabPart	
Set-Member	MT, KM, JG
Process-Step	MT, HP, HI, MP, DL
Whole-Part	MT, HI, HL, KM, JG, MP, AC, DL
Elab-Generality	
General-Specific	MT, HP, JH, KM, JG, TNR, HS, MP, KD, AC, NS, RC, QG, MH, IMM
Abstract-Instance	MT, HP, JH, KM, LP, TNR, JG, HS, MP, MM, RC, QG, MH, IMM
Identification	KM, JG, HS, MP, KD, AC, MM, QG, ST, RJ
Restatement	MT, KM, KD, DSN, NS, RR, RC, QG, MH, WL, IMM
Conclusion (interp at end)	KM, JG, HS, KD, RR, RC, QG
Summary (short restatement)	MT, DSN, RC, QG
Circumstance	MT, JG, DSN, QG
Location	HI, HL, KD, QG, RJ, MH
Time	HI, HL, TNR, KD, QG, RJ, MH, IMM
Means	MP, QG, ST, MH
Manner	QG, MH, IMM, SSN
Instrument	QG
Parallel-Event	KD, QG, RJ
Sequence	MT, JH, LP, KD, DSN, RC
Seq-Temporal	HI, HP, LP, DL, NS, MH
Seq-Spatial	NS
Seq-Ordinal	LP, DSN, QG
Cause/Result	JH, KM, TNR, JG, GH, KD, LP, RL, RR, RC, QG, RJ, SA, MH, LA, IMM, SSN
C/RVol (volitional)	IMM
Vol-Cause	MT
Vol-Result	MT, WL
C/RNonvol (nonvolitional)	IMM
NonVol-Cause	MT
NonVol-Result	MT, MP
Purpose	MT, HP, KD, QG, SA, MH, IMM, SSN
General-Condition	IMM
Condition	MT, JG, LP, RL, DL, RC, MH, IMM, SSN
Exception	RL, MH, SSN
Comparative	IMM

Equative (like, while)	JG, TNR, DL, QG, MH, IMM
Contrast	MT, JH, LP, IR, TNR, MP, RL, GH, BF, KD, NS, DSN, RC, QG, WL, IMM
Otherwise (if then else)	MT, LP, NS, RL, RC, QG, MH, IMM
Comparison	KM, HS, MH
Analogy	KM, JG, MP, RR
Interpersonal	MH
Interpretation	MT, KD, IMM
Evaluation (A opinion)	MT, KD, JH
Enablement	MT, JH, HL, TNR, MP, KD, DSN, DL, SA, LA
Background	MT, JH, HL, MP
Antithesis	MT, DSN, JG, HS, KM, QG, SSN
Exhortation	
Support	RR, RC
Solutionhood (general prob)	MT
Answer (numeric prob)	KM
Evidence (support claim)	MT, KM, JG, MP, BF, KD, ST, WL, IMM, SSN
Proof	MP
Justification (for A act)	MT, IR, DL, WL
Motivation (for R act)	MT, MP, DSN, DL, MM, IMM, SSN
Concession	MT, DSN, KD, RR, IMM, QG, MH
Qualification	ST, IMM
Textual	MH, IMM
Logical-Relation	
Conjunction	MT, DSN, RC, QG, MH, IMM
Disjunction	QG, MH, IMM
Pres-Sequence	IMM
Joint	KM, RC, KD, GH, JH, MT, IMM

(Note: Not all relations of QG and RJ are interclausal; some are intraclausal.)

In order to facilitate further investigations of relation definitions, we provide here our cross-classification of our sources' relations (in the left-hand column) and the corresponding relation from our taxonomization (Figure 1).

AC: [Cawsey 90]	
AC:HowItWorks	(script)
AC:WhatItDoes	(script)
AC:Identification	Identificatio
AC:Constituency	WholePart
AC:ComponentIdentfctn	WholePart, Identification
AC:ParticularBehaviour	GeneralSpecific
BF: [Fox 84]	
BF:Issue	Elaboration
BF:Contrast	Contrast
BF:Evidence	Evidence
BF:Elaboration	Elaboration
DL: [Litman 85]	
DL:Step	ProcessStep
DL:After	SeqTemporal
DL:Next	SeqTemporal
DL:Contains	WholePart, ProcessStep
DL:Motivates	Motivation, Justification
DL:Enables	Enablement
DL:Equal	Comparison
DL:Parameter	WholePart (sub)
DL:Condition	Condition
DSN: [De Souza et al. 89]	
DSN:Antithesis	Antithesis
DSN:Summary	Summary
DSN:Restatement	Restatement
DSN:List	SeqOrdinal (sub)
DSN:Concession	Concession
DSN:Circumstance	Circumstance
DSN:Elaboration	Elaboration
DSN:Contrast	Contrast
DSN:Joint	Joint
DSN:Sequence	Sequence
DSN:MotivatnEnablmnt	Motivation, Enablement
GH: [Hirst 81]	
GH:Cause	Cause
GH:Parallel	Parallel (other)
GH:Contrast	Contrast
GH:Elaboration	Elaboration
HI, HL, HP: [Hovy 90a, Hovy 89, Hovy 88]	
HI:Sequence	SeqTemporal
HI:Circumstance	Time, Location
HI:Attribute	ObjctAttrib, Wholepart
HI:Details	ProcessStep
HL:Description	(script)
HL:Access	(script)
HL:Features	(script)
HL:Open	Enablement (sub)
HL:Cost	Enablement (sub)
HL:IntFeature	ObjectAttribute
HL:History	Background (sub)
HL:ElabPartWhole	Wholepart
HL:ElabDetails	ObjctAttrib, ObjctFnctn
HL:CircumstanceLoc	Location
HL:CircumstanceTime	Time
HP:Sequence	SeqTemporal
HP:Purpose	Purpose
HP:Elaboration	GeneralSpecific, AbstractInstance, ProcessStep
HS: [Shepherd 26]	
HS:Comparison	Comparison
HS:IllustrationGeneral	AbstractInstance
HS:Amplification	GeneralSpecific
HS:Conclusion	Conclusion
HS:Topic	Identification
HS:IllustrationPartIr	AbstractInstance
HS:Contrasting	Antithesis
IMM: [Ivir et al. 80]	
IMM:Conjunction	Conjunction
IMM:Additive	
IMM:Additive-smpl	Conjunction (sub)
IMM:Additive-emph	Conjunction (sub)
IMM:Converse	Contrast (sub)
IMM:Disjunction	Disjunction
IMM:Simple-Disjnctn	Disjunction
IMM:Replacive	Otherwise
IMM:Reformulation	Elaboration
IMM:Illustrative	GeneralSpecific
IMM:I.e.	AbstractInstance
IMM:Concise-refmltn	Equative
IMM:Preferred-rfmltn	Restatement (sub)
IMM:Contradictn-Contrst	Comparative
IMM:Contradiction	Concession
IMM:Opposing-factors	Contrast

IMM:Concessive	Concession
IMM:Contradict-rlty	Concession (sub)
IMM:Contrary	Evidence
IMM:Contrast	Contrast
IMM:Contrastive-neg	Contrast
IMM:Rhetorical-Links	Textual
IMM:Serial-Order	Pres-Sequence
IMM:Instncs-1-gnlzn	Joint
IMM:Continuity	NextTopic
IMM:Resmptn-theme	PreviousTopic
IMM:Breach	(dialogue)
IMM:Attitude	Interpretation?
IMM:Focus-Directing	?
IMM:Gratis-Addition	Evidence
IMM:Specific-Shift	General-Specific
IMM:General-Shift	General-Specific
IMM:Retrospective-Ref	Elab-Object
IMM:Adverbs-as-Reltrs	
IMM:Causation	Cause-Result
IMM:Inference	Evidence
IMM:Reason-Simple	C/RVol, Nonvol
IMM:Reason-Emph	C/RVol, Nonvol
IMM:Exceptional	C/RVol, Nonvol
IMM:Purpose	Purpose
IMM:Purpose-pos	Purpose
IMM:Purpose-neg	Purpose
IMM:Result-Cause	Cause-Result
IMM:Result	Cause-Result
IMM:Cause	Cause-Result
IMM:Obvious-Cause	Cause-Result (sub)
IMM:Non-Real-Cause	Cause-Result (sub)
IMM:Contradcty-Cse	Cause-Result (sub)
IMM:Hypoth-Cause	Cause-Result (sub)
IMM:Manner-Causation	Manner
IMM:Conditionality	General-Condition
IMM:Concomitant-Var	General-Condition (sub)
IMM:Eventlty-Cnsid	Condition
IMM:Considerative	Qualification
IMM:Condition-Met	Condition
IMM:Comparative-Deg	Condition (sub)
IMM:Temp-Spat-Cond	Condition (sub)
IMM:Condition-Neg	Qualification
IMM:Condition-Irrl	Condition (sub)
IMM:Conditn-Impsd	Condition (sub)
IMM:Conditn-Imagnd	Condition (sub)
IMM:Cond-Flfmnt-Ad	Condition (sub)
IMM:Degree-Manner	Comparative
IMM:Degree	Comparative (sub)
IMM:Manner	Comparative (sub)
IMM:Temporal	Time
IMM:Simultaneity	Time (sub)
IMM:Non-Simultnty	Time (sub)
IMM:Precedence	Time
IMM:Subsequence	Time
IR: [Rankin 89]	
IR:Justify	Justification
IR:Alternative	Contrast
JG: [Grimes 75]	
JG:Paratactic	SatisfactionPreceding
JG:Hypotactic	Dominating
JG:Supporting	? Dominating
JG:Setting	Circumstance
JG:Identification	Identification
JG:Specifically	Elaboration
JG:Attributive	ObjectAttribute
JG:Equivalent	Restatement
JG:Specification	GeneralSpecific
JG:Explanation	Cause/Result
JG:Evidence	Evidence
JG:Analogy	Analogy
JG:Representative	AbstractInstance
JG:Constituency	WholePart, SetMember
JG:Covariance	Condition (sub)
JG:Alternatives	Antithesis
JG:CauseEffect	Cause/Result
JG:Adversative	Antithesis (sub)
JG:Inference	Conclusion, Cause/Result
JH: [Hobbs 78, Hobbs 79, Hobbs 82, Hobbs 90]	
JH:Occasion	Sequence (sub)
JH:Enablement	Enablement
JH:Cause	Cause
JH:Evaluation	Evaluation
JH:Background-Fnctnl	Background (sub)
JH:Background-Visual	Background (sub)
JH:Explanation	Cause/Result (sub)
JH:Parallel	Parallel (other)
JH:Elaboration	Elaboration
JH:Generalization	GeneralSpecific
JH:Example	AbstractInstance

JH:Contrast	Contrast
JH:ViolatedExpctatn	Contrast (sub)
KD: [Dahlgren 88]	
KD:Sequence	Sequence
KD:Reported-Event	Elaboration, Interpretation
KD:Enablement	Enablement
KD:Cause	Cause
KD:Goal	Purpose
KD:Parallel	Parallel (other)
KD:Contrast	Contrast
KD:Evidence	Evidence
KD:Generalization	GeneralSpecific
KD:Elaboration	Elaboration
KD:Restatement	Restatement
KD:Qualification	Concession
KD:Evaluation	Evaluation
KD:Description	Identification
KD:Situation	Circumstance
KD:Situation-Acty	Circumstance (sub)
KD:Situation-Time	Time
KD:Situation-Place	Location
KD:Import	Interprettn, Conclsn (sub)
KD:Unbi edCmnt	Interpretation
KD:BiasedCmnt	Evaluation
KM: [McKeown 85]	
KM:Identification	(script)
KM:Constituency	(script)
KM:Attributive	(script)
KM:CompareContrast	(script)
KM:Attributive	ObjectAttribute
KM:Amplification	ObjectAttribute (sub)
KM:IllustratnPrtclr	AbstractInstance
KM:Representative	AbstractInstance (sub)
KM:Answer	Answer
KM:Comparison	Comparison
KM:Adversative	Antithesis
KM:Explanation	Cause/Result (sub)
KM:Inference	Conclsn, Cause/Rslt (sub)
KM:Identificatn-Class	Identification
KM:Identificatn-Fnctn	ObjectFunction
KM:Analogy	Analogy
KM:Constituency	WholePart, SetMember
KM:Renaming	Restatement (sub)
KM:Evidence	Evidence
KM:CauseEffect	Cause/Result
KM:IdentifictnDpth	ObjectAttribute (sub)
KM:IdentifictnAttr	ObjectAttribute
KM:Positing	Identification (sub)
KM:Generalization	GeneralSpecific
LA: [Lascarides & Asher 91]	
LA:Cause	Cause/Result
LA:Elaboration	Elaboration
LA:Background	Background
LA:Result	Cause/Result
LP: [Polanyi 88]	
LP:Sequential	SatisfactionPreceding
LP:Expansion	Dominating
LP:Interruption	(dialogue)
LP:Binary	Cause/Result, Otherwise, Condition
LP:Expansion	ObjectAttribute
LP:Sequence	Sequence
LP:Sequence-List	SeqOrdinal
LP:Seqnce-TopicChain	NextTopic (other)
LP:Seqnce-Narrative	SeqTemporal
LP:Instance	Instance
LP:Elaboration	ObjectAttribute
LP:EvaluativeCmnt	Evaluation
LP:Contrast	Contrast
MH: [Halliday 85]	
MH:Elaboration	
MH:Exposition	Restatement
MH:Exemplification	GenlSpec, AbstInstnce
MH:Clarification	ObjectAttribute (sub)
MH:Extension	
MH:Addition	
MH:Additive	Conjunction
MH:Adversative	Conjunction (sub, neg)
MH:Variation	
MH:Replacive	Otherwise
MH:Subtractive	Exception
MH:Alternative	Disjunction
MH:Enhancement	
MH:Temporal	
MH:SameTime	Equative (sub)
MH:DiffntTime	SeqTemporal
MH:Spatial	Location

MH:Manner	
MH:Means	Means, Manner
MH:Comparison	Comparison
MH:Causal	
MH:Reason	Cause/Result
MH:Purpose	Purpose
MH:ConditionPos	Condition
MH:ConditionNeg	Condition (sub: neg)
MH:Concessive	Concession

MM: [Maybury 90]

MM:Identification	Identification
MM:SupptCharstic	ObjectAttribute
MM:SupportClassify	AbstractInstance
MM:Recommend	Motivation

MP: [Moore 89, Moore & Swartout 90, Paris 90]

MP:RcmndEnablMtvt	(script)
MP:MakeComptnt	Enablement
MP:Persuade	Motivation
MP:PrsByMot	Motivation
MP:ElbPrcStp	ProcessStep
MP:PrsInstOf	AbstractInstance
MP:EvdInstOf	AbstractInst, Evdnce
MP:ProveResult	Proof
MP:ElabGenSpStp	GeneralSpecific
MP:InfmAndPersde	(script)
MP:Contrast	Contrast
MP:Differences	Contrast
MP:Difference	Contrast
MP:Describe	(script)
MP:ClsAsc&Rls	Identification
MP:Generalize	GeneralSpecific
MP:Instance	AbstractInstance
MP:Analogy	Analogy
MP:Part	WholePart
MP:Use	ObjectFunction
MP:Proof	Proof
MP:PrfModusPns	Proof (sub)
MP:ProofByMeans	Proof (sub)
MP:Motivation	Motivation
MP:MotReplAct	Motivation (sub)
MP:MotAct	Motivation
MP:MotActByMns	Motivation (sub)
MP:Means	Means
MP:Elaboration	Elaboration
MP:General-Spec	GeneralSpecific
MP:Process-Step	ProcessStep
MP:Object-Attr	ObjectAttribute
MP:Concept-Ex	AbstractInstance
MP:WholePart	WholePart
MP:Background	Background
MP:Backgrnd-Def	Background (sub)
MP:Backgrnd-Sub	Background (sub)
MP:Evidence	Evidence
MP:Contrast	Contrast
MP:Abstraction	GeneralSpecific
MP:Consequence	NonVolResult

MT: [Mann & Thompson 88, Mann & Thompson 86]

MT:Sequence	Sequence
MT:Cause/Result	Cause/Result
MT:VolCause	VolitionalCause
MT:VolResult	VolitionalResult
MT:NonVolCause	NonVolitionalCause
MT:NonVolResult	NonVolitionalResult
MT:Purpose	Purpose
MT:Enablement	Enablement
MT:Solutionhood	Solutionhood
MT:Restatement	Restatement
MT:Summary	Summary
MT:Contrast	Constrast
MT:Antithesis	Antithesis
MT:Otherwise	Otherwise
MT:Condition	Condition
MT:Joint	Conjunction
MT:Circumstance	Circumstance
MT:Elaboration	Elaboration
MT:Elab-ObjAttr	ObjectAttribute
MT:Elab-SetMemb	SetMember
MT:Elab-WhlePrt	WholePart
MT:Elab-ProcStep	ProcessStep
MT:Elab-GenlSpec	GeneralSpecific
MT:Elab-AbstInst	AbstractInstance
MT:Evidence	Evidence
MT:Justification	Justification
MT:Motivation	Motivation
MT:Concession	Concession
MT:Interpretation	Interpretation
MT:Evaluation	Evaluation
MT:Background	Background

NS: [Simonin 88]

NS:Contrast	Contrast
NS:Restatement	Restatement
NS:Restriction	Otherwise
NS:SpatialOrder	SeqSpatial
NS:TemporalOrder	SeqTemporal
NS:GeneralSpecific	GeneralSpecific

QG: [Quirk & Greenbaum 73]

Note — not all these are interclausal

1: - interclausal relations -

QG:Time	Time
QG:Ordinals	SeqOrdinal
QG:Place	Location
QG:And	Conjunction
QG:Enumeration	SeqOrdinal
QG:Addition	Conjunction
QG:Transition	NextTopic (other)
QG:Summation	Summary
QG:Apposition	Restatement
QG:Result	Cause/Result
QG:Inference	Conclusion, Cause/Result
QG:OrRefmlnRplmnt	Disjunction, Restatement
QG:But	Otherwise
QG:Contrast	Contrast
QG:Concession	Concession
QG:ConcessionNml	Concession
QG:ConcessionPrt	Concession
QG:ConcessionNom	Concession
QG:For	Cause/Result, Conclusion

2: - intraclausal conjuncts -

QG:Enumerative	SeqOrdinal
QG:Reinforcing	Conjunction (sub)
QG:Equative	Conjunction (sub)
QG:Transitional	NextTopic (other)
QG:Summative	Conclusion
QG:Apposition	Restatement
QG:Result	Cause/Result
QG:Inferential	Conclusion, Cause/Result
QG:Reformulatory	Restatement (sub)
QG:Replacive	Otherwise
QG:Antithetic	Antithesis
QG:Concessive	Concession
QG:TemporalTrnsitn	Circumstance (sub)

QG: - apposition in noun phrases -

QG:Appellation	Identification (sub)
QG:Designation	Ident (sub), Restmnt
QG:Identification	Identification
QG:Reformulation	Restatement
QG:Attribution	Elaboration
QG:Inclusion	GenlSpec, AbstInst

3: - some types of adjuncts -

QG:Place	Location
QG:Position	Location (sub)
QG:Direction	Location (sub)
QG:Time	Time
QG:When	Time (sub)
QG:Duration	Time (sub)
QG:Frequency	Time (sub)
QG:Relational	Equative (sub)
QG:Process	Circumstance
QG:Means	Means
QG:Instrument	Instrument
QG:Manner	Manner
QG:Other	
QG:Purpose	Purpose
QG:Result, Cause	Cause/Result

RC: [Cohen 83]

RC:Parallel	Sequence, Condition, Conjunction, Parallel
RC:Summary	Summary
RC:Reformulation	Restatement
RC:Detail	GenlSpec, AbstInst
RC:Inference	Cause/Result, Concl
RC:Contrast	Contrast, Otherwise
RC:EvidenceSupport	Support
RC:Claim	Identification (sub)

RJ: [Jackendoff 83]

Note — Not all of these are interclausal

RJ:SpatialLocMotion	Circumstance
RJ:SpatialLocation	Location
RJ:Causative	Cause/Result
RJ:Temporal	Time
RJ:Possessive	? (not interclausal)
RJ:Identificational	Identification
RJ:Circumstantial	ParallelEvent
RJ:Existential	? (not interclausal)

RL: [Longacre 76]

RL:Exception	Exception
RL:BinaryParagraph	Cause/Result, Otherwise,

	Condition
RR: [Reichman 78]	
RR:Support	Support, Cause/Result
RR:RestmntCnclsn	Restatement, Conclusion
RR:Concession	Concession
RR:Analogy	Analogy
RR:TextDevelopment	NextTopic (other)
RR:Interruption	(dialogue)
RR:RetnToPrevTopic	PreviousTopic (other)
RR:IndrectChallnge	(dialogue)
RR:DirectChallenge	(dialogue)
RR:PriorLgclAbstrn	PrevTopic (other) (sub)
SA: [Schank & Abelson 77]	
SA:Result	Cause/Result
SA:Enable	Enablement
SA:Initiate	Cause/Result (sub)
SA:ReasonFor	Purpose
SA:Disable	?
SSN: [Sanders et al. 92]	
SSN:Cause-Conseq	Cause/Result
SSN:Contr-Cse-Consq	Exception, Antithesis ?
SSN:Conseq-Cause	Cause/Result
SSN:Contr-Consq-Cse	Exception, Antithesis ?
SSN:Argument-Claim	Evidence
SSN:Instrument-Goal	Purpose, Manner
SSN:Condition-Consq	Condition
SSN:Contr-Arg-Claim	Concession (sub)
SSN:Claim-Argument	Evidence
SSN:Goal-Instrument	Purpose
SSN:Conseq-Conditn	Condition
SSN:Contr-Clm-Arg	Concession, Antithesis ?
SSN:List	Joint
SSN:Exception	Exception
SSN:Opposition	Antithesis
SSN:Enumeration	Joint, Pres-Sequence
SSN:Concession	Concession
ST: [Toulmin 58]	
ST:Claim	Identification (sub)
ST:Data	Evidence (sub)
ST:Warrant	Means
ST:Backing	Evidence (sub)
ST:ModalQualification	Qualification
ST:PossibleRebuttals	Qualification (sub)
TNR: [Tucker et al. 86]	
TNR:Temporal	Time
TNR:Condition	Cause/Result, Enablement (sub)
TNR:Contrastive	Contrast
TNR:Equivalent	Restatement (sub)
TNR:Expansion	AbstractInstance
TNR:Generalization	GeneralSpecific
TNR:Similar	Restatement
TNR:Digression	(dialogue)
WL: [Wu & Lytinen 90]	
WL:Evidence	Evidence
WL:Justification	Justification
WL:Elaboration	Elaboration
WL:Contrast	Contrast
WL:Restatement	Restatement
WL:Volitional-Result	VolitionalResult

References

[Arens et al. 88] Arens, Y., Miller, L., Shapiro, S.C., & Sondheimer, N.K. (1988). Automatic Construction of User-Interface Displays. *Proceedings of the 7th AAAI Conference*, St. Paul. Also available as USC/Information Sciences Institute Research Report RR-88-218.

[Aristotle] Aristotle. The Rhetoric. Translation in *The Rhetoric and the Poetics of Aristotle*, W. Rhys Roberts (trans), 1954, New York: Random House.

[Asher 93] Asher, N. (1993). *Reference to Abstract Objects in Discourse*. Boston: Kluwer Academic Press.

[Birnbaum et al. 80] Birnbaum, L.A., Flowers, M., & McGuire, R. (1980). Towards an AI Model of Argumentation. *Proceedings of the 1st AAAI Conference*, Stanford, 195–198.

[Björklund & Virtanen 89] Björklund, M. & Virtanen, T. (1989). Variation in Narrative Structure: A Simple Text vs. an Innovative Work of Art. Presented at the *16th International Systemics Congress*, Helsinki.

[Cawsey 90] Cawsey, A. (1990). Generating Communicative Discourse. In R. Dale, C. Mellish, and M. Zock (Eds.), *Current Research in Natural Language Generation*. Boston: Academic Press, 75–102.

[Cohen 83] Cohen, R. (1983). *A Computational Model for the Analysis of Arguments*. Technical Report CSRG-151, University of Toronto.

[Dahlgren 88] Dahlgren, K. (1988). *Naive Semantics for Natural Language Understanding*. Boston: Kluwer Academic Press.

[De Souza et al. 89] De Souza, C.S., Scott, D.R. & Nunes, M.G.V. (1989). Enhancing Text Quality in a Question-Answering System. Unpublished manuscript, Pontificia Universidade Católica de Rio de Janeiro.

[Dobeš & Novak 92] Dobeš, Z. & Novak, H-J. (1992). From Constituent Planning to Text Planning. In H. Horacek (Ed.), *New Concepts in Natural Language Generation: Planning, Realization, and Systems*. London: Pinter 155–172.

[Fox 84] Fox, B. (1984). *Discourse Structure and Anaphora in Written and Conversational English*. Unpublished doctoral dissertation, University of California in Los Angeles.

[Gazdar et al. 85] Gazdar, G., Klein, E., Pullum, G.K., & Sag, I.A. (1985). *Generalized Phrase Structure Grammar*. Cambridge: Harvard University Press.

[Graesser & Clark 85] Graesser, A. & Clark, L.F. (1985). *Structure and Procedures of Implicit Knowledge*. London: Ablex.

[Grimes 75] Grimes, J.E. (1975). *The Threaa of Discourse*. The Hague: Mouton.

[Gross 84] Gross, M. (1984). Lexicon-grammar and the syntactic analysis of French. *Proceedings of the 10th Coling Conference*, Stanford, 325–331.

[Grosz 81] Grosz, B.J. (1981). Focusing and Description in Natural Language Dialogues. In A. Joshi, B. Webber, & I. Sag (Eds.), *Elements of Discourse Understanding*. Cambridge: Cambridge University Press 213-235.

[Grosz & Sidner 86] Grosz, B.J. & Sidner, C.L. (1986). Attention, Intentions, and the Structure of Discourse. *Journal of Computational Linguistics* 12(3) 175–204.

[Halliday 85] Halliday, M.A.K. (1985). *An Introduction to Functional Grammar*. Baltimore: Edward Arnold Press.

[Hasan 78] Hasan, R. (1978). Text in the Systemic-Functional Model. In W.U. Dressler (Ed.), *Current Trends in Text Linguistics* Berlin and New York: De Gruyter 228–246.

[Hirschberg & Litman 87] Hirschberg, J. & Litman, D. (1987). Now Let's Talk about Now: Identifying Cue Phrases Intonationally. *Proceedings of the 25th ACL Conference*, Chicago, 59–64.

[Hirst 81] Hirst, G. (1981). Discourse-Oriented Anaphora Resolution: A Review. *Journal of Computational Linguistics* 7 85–98.

[Hobbs 78] Hobbs, J.R. (1978). Why is Discourse Coherent? Technical Note no. 176, SRI International, Menlo Park.

[Hobbs 79] Hobbs, J.R. (1979). Coherence and Coreference. *Cognitive Science* 3(1), 67–90.

[Hobbs 82] Hobbs, J.R. (1982). Coherence in Discourse. In W.G. Lehnert & M.H. Ringle (Eds.), *Strategies for Natural Language Processing*. Hillsdale: Lawrence Erlbaum Associates, 223–243.

[Hobbs 90] Hobbs, J.R. (1990). *Literature and Cognition*. CSLI Lecture Notes no. 21.

[Hovy 88] Hovy, E.H. (1988). Planning Coherent Multisentential Text. *Proceedings of the 26th ACL Conference*, Buffalo, 163–169.

[Hovy 89] Hovy, E.H. (1989). Notes on Dialogue Management and Text Planning in the LILOG Project. Unpublished working document, Projekt LILOG, Institut für Wissensbasierte Systeme, IBM Deutschland, Stuttgart.

[Hovy 90a] Hovy, E.H. (1990). Approaches to the Planning of Coherent Text. In C.L. Paris, W.R. Swartout, & W.C. Mann (Eds.), *Natural Language in Artificial Intelligence and Computational Linguistics*. Boston: Kluwer, 83–102.

[Hovy 90b] Hovy, E.H. (1990). Parsimonious and Profligate Approaches to the Question of Discourse Structure Relations. *Proceedings of the 5th International Workshop on Text Generation*, Pittsburgh, 59–65.

[Hovy 93] Hovy, E.H. (1993). In Defense of Syntax: Informational, Intentional, and Rhetorical Structures in Discourse. *Proceedings of the ACL Workshop on Intentionality and Structure in Discourse Relations*, Columbus, 35–39.

[Hovy & Arens 90] Hovy, E.H. and Arens, Y. (1990). Automatic Generation of Formatted Text. *Proceedings of the 8th AAAI Conference*, Anaheim, 313–317.

[Hovy et al. 92] Hovy, E.H., Lavid, J., Maier, E., Mittal, V., and Paris, C.L. (1992). Employing Knowledge Resources in a New Text Planner Architecture. In R. Dale, E.H. Hovy, D. Rösner, & O. Stock (Eds.), *Aspects of Automated Natural Language Generation*. Heidelberg: Springer Verlag Lecture Notes in AI number 587, 57–72.

[Ivir et al. 80] Ivir, V., McMillan, D. & Merz, T. (1980). S-Relators. Unpublished manuscript, University of Zagreb.

[Jackendoff 83] Jackendoff, R. (1983). *Semantics and Cognition*. Cambridge: MIT Press.

[Kamp 81] Kamp, H. (1981). A theory of truth and semantic representation. In J.A.G. Groenendijk, T.M.V. Janssen & M.B.J. Stokhof (Eds.), *Formal Methods in the Study of Language*. Mathematical Centre Tracts (vol 136), Amsterdam, 277–322.

[Kintsch & Van Dijk 75] Kintsch, W. & Van Dijk, T. (1975). Recalling and Summarizing Stories. *Language* 40, 98–116.

[Knott & Dale 93] Knott, A. & Dale, R. (1993). Using Linguistic Phenomena to Motivate a Set of Coherence Relations. *Discourse Processes* (to appear).

[Lambert & Carberry 91] Lambert, L. & Carberry, S. (1991). A Tripartite Plan-Based Model of Dialogue. *Proceedings of the 29th Conference of the Association for Computational Linguistics*, Berkeley, 47–54.

[Lascarides & Asher 91] Lascarides, A. & Asher, N. (1991). Discourse Relations and Defeasible Knowledge. *Proceedings of the 29th Conference of the Association for Computational Linguistics*, Berkeley, 71–78.

[Lehnert 82] Lehnert, W.G. (1982). Plot Units: A Narrative Summarization Strategy. In W.G. Lehnert & M.H. Ringle (Eds.), *Strategies for Natural Language Processing*. Hillsdale: Lawrence Erlbaum Associates, 375–414.

[Levy 84] Levy, E. (1984). *Communicating Thematic Structures in Narrative Discourse: The Use of Referring Terms and Gestures*. Unpublished doctoral dissertation, University of Chicago.

[Litman 85] Litman, D.J. 1985)(. *Plan Recognition and Discourse Analysis: An Integrated Approach for Understanding Dialogues*. Unpublished doctoral dissertation, University of Rochester.

[Longacre 76] Longacre, R. (1976). *An Anatomy of Speech Notions*. Lisse: Peter de Ridder Press.

[Maier & Brown 90] Maier, E. & Brown, M. 1990)(. A Goal-Oriented Treatment of Text Structures in Text Planning. Unpublished working paper, Arbeitspapiere der GMD no. 484, IPSI, Darmstadt.

[Maier & Hovy 92] Maier, E. & Hovy, E.H. (1992). Organizing Discourse Structure Relations using Metafunctions. In H. Horacek (Ed.), *New Concepts in Natural Language Generation: Planning, Realization, and Systems*. London: Pinter, 178–201.

[Mann & Thompson 86] Mann, W.C. & Thompson, S.A. 1986)(. Rhetorical Structure Theory: Description and Construction of Text Structures. In G. Kempen (Ed.), *Natural Language Generation: New Results in Artificial Intelligence, Psychology, and Linguistics*. Boston: Kluwer Academic Publishers, 279–300.

[Mann & Thompson 88] Mann, W.C. & Thompson, S.A. 1988)(. Rhetorical Structure Theory: Toward a Functional Theory of Text Organization. *Text* 8(3), 243–281. Also available as USC/Information Sciences Institute Research Report RR-87-190.

[Marslen-Wilson et al. 82] Marslen-Wilson, W., Levy, E., & Tyler, L.K. (1982). Producing Interpretable Discourse: The Establishment and Maintenance of Reference. In R.J. Jarvella & W. Klein (Eds.), *Speech, Place and Action*. New York: John Wiley and Sons, 339–378.

[Martin 92] Martin, J.R. (1992). *English Text: System and Structure*. Amsterdam: Benjamins Press.

[Maybury 90] Maybury, M.T. (1990). *Planning Multisentential English Text Using Communicative Acts*. Unpublished doctoral dissertation, Cambridge University. Also available as RADC Technical Report 90-411.

[McKeown 85] McKeown, K.R. (1985). *Text Generation: Using Discourse Strategies and Focus Constraints to Generate Natural Language Text*. Cambridge: Cambridge University Press.

[Mel'čuk & Žholkovsky 70] Mel'čuk, I.A. & Žholkovsky, A.K. 1970)(. Towards a Functioning Meaning-Text Model of Language. *Linguistics* 57, 10–47.

[Moore 89] Moore, J.D. (1989). *A Reactive Approach to Explanation in Expert and Advice-Giving Systems*. Unpublished doctoral dissertation, University of California in Los Angeles.

[Moore & Pollack 93] Moore, J.D. & Pollack, M.E. (1993). A Problem for RST: The Need for Multi-Level Discourse Analysis. Squib in *Computational Linguistics* 18 (4), 23–27.

[Moore & Swartout 90] Moore, J.D. & Swartout, W.R. (1990). Dialogue-Based Explanation. In C.L. Paris, W.R. Swartout & W.C. Mann (Eds.), *Natural Language in Artificial Intelligence and Computational Linguistics*. Boston: Kluwer, 3–48.

[Paris 87] Paris, C.L. (1987). *The Use of Explicit Models in Text Generation: Tailoring to a User's Level of Expertise*. Unpublished doctoral dissertation, Columbia University.

[Paris 90] Paris, C.L. (1990). Generation and Explanation: Building an Explanation Facility for the Explainable Expert Systems Framework. In C.L. Paris, W.R. Swartout & W.C. Mann (Eds.), *Natural Language in Artificial Intelligence and Computational Linguistics*. Boston: Kluwer, 49–82.

[Passoneau 91] Passoneau, R.J. (991.) Getting and keeping the center of attention. In R. Weischedel & M. Bates (Eds.), *Challenges in Natural Language Processing*. Cambridge: Cambridge University Press, 35–38.

[Passoneau & Litman 93] Passoneau, R.J. & Litman, D.J. (1993). Intention-Based Segmentation: Human Reliability and Correlation with Linguistic Cues. *Proceedings of the 31st Conference of the Association for Computational Linguistics*, Columbus, 148–155.

[Pierrehumbert & Hirschberg 87] Pierrehumbert, J. & Hirschberg, J. (1987). The meaning of intonational contours in the interpretation of discourse. AT&T Bell Laboratories Technical Report TM 11225-870325-07.

[Polanyi 88] Polanyi, L. (1985). A formal Model of the Structure of Discourse. *Journal of Pragmatics* 12, 601–638.

[Quirk & Greenbaum 73] Quirk, R. & Greenbaum, S. (1973). *A Concise Grammar of Contemporary English*. New York: Harcourt Brace Jovanovich Inc.

[Rambow 90] Rambow, O. (1990). Domain Communication Knowledge. *Proceedings of the 5th International Workshop on Text Generation*, Pittsburgh, 98–107.

[Rankin 89] Rankin, I. (1989). *The Deep Generation of Text in Expert Critiquing Systems*. Unpublished licentiate thesis, University of Linköping, Sweden.

[Redeker 91] Redeker, G. (1993). Linguistic Markers of Discourse Structure. *Linguistics* 29, 1139–1172.

[Redeker 93] Redeker, G. (1993). The Parallel Components Model of Discourse Coherence. MS in prep.

[Reichman 78] Reichman, R. (1978). Conversational Coherency. *Cognitive Science* 2 283–327.

[Rumelhart 72] Rumelhart, D.E. (1972). Notes on a Schema for Stories. In D.G. Bobrow & A. Collins (Eds.), *Representation and Understanding*. New York: Academic Press, 155–175.

[Sanders et al. 92] Sanders, T.J.M., Spooren, W.P.M.S., & Noordman, L.G.M. (1992). Towards a Taxonomy of Coherence Relations. *Discourse Processes* 15 (1), 1–36.

[Schank & Abelson 77] Schank, R.C. & Abelson, R. (1977). *Scripts, Plans, Goals, and Understanding*. Hillsdale: Lawrence Erlbaum Associates.

[Shepherd 26] Shepherd, H.R. (1926). *The Fine Art of Writing*. New York: The Macmillan Co.

[Shieber 84] Shieber, S. (1984). Direct Parsing of ID/LP Grammars. *Linguistics and Philosophy* 7, 135–154.

[Simonin 88] Simonin, N. (1988). An Approach for Creating Structured Text. In M. Zock & G. Sabah (Eds.), *Advances in Natural Language Generation* vol. 1. London: Pinter Publishers, 146–160.

[Sycara 87] Sycara, K. (1987). *Resolving Adversarial Conflicts: An Approach Integrating Case-Based and Analytical Methods*. Unpublished doctoral dissertation, Georgia Institute of Technology.

[Toulmin 58] Toulmin, S. (1958). *The Uses of Argument*. Cambridge: Cambridge University Press.

[Trabasso et al. 85] Trabasso, T. & Sperry, L.L. (1985). Causal Relatedness and Importance of Story Events. *Journal of Memory and Language* 24 (2), 595–611.

[Tucker et al. 86] Tucker, A.B., Nirenburg, S., & Raskin, V. (1986). Discourse and Cohesion in Expository Text. *Proceedings of Coling-86*, 181–183.

[Wu & Lytinen 90] Wu, H.J.P. & Lytinen, S.L. (1990). Coherence Relation Reasoning in Persuasive Discourse. *Proceedings of the 12th Conference of the Cognitive Science Society*, Cambridge, 503–510.